

STATE OF IDAHO
DEPARTMENT OF FISH AND GAME
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TIME, SIZE, AND ESTIMATED NUMBERS OF SEAWARD
MIGRATIONS OF CHINOOK SALMON AND STEELHEAD
TROUT IN THE BROWNLEE--OXBOW SECTION OF THE
MIDDLE SNAKE RIVER

by

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Boise, Idaho
March 1, 1959

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INTRODUCTION

This study was part of a cooperative project among the fishery agencies of Oregon and Idaho, the Fish And Wildlife Service and Idaho Power Company under terms of the latter's license for construction of dams in the middle Snake River. The purpose of the project was to investigate fishery conditions and problems arising from the construction of Brownlee and Oxbow Dams and thus prevent losses to the fishery or to mitigate for losses. This particular phase of the study was intended to:

- (1) Determine the time and size of seaward. migrations of chinook salmon and steelhead trout at Brownlee Dam.
- (2) Estimate numbers of downstream migrating salmon and steelhead.
- (3) Study the downstream migrations or dispersion of anadromous fish in important tributaries of the impoundment area.

The first phase of the study, operation of a downstream migrant trap-ping barge, was started April 10, 1957.

METHODS AND TECHNIQUES USED

Downstream Migrant Trapping Barge:

The barge used at Brownlee was constructed in sections in Boise and hauled to the dam. It was then assembled on the bank of the river (Plate 1) adjacent to the bridge just below Brownlee dam (Figure 1) and lowered into the water with a crane (Plate 2). The barge was 22 feet long and 14 feet wide. Buoyancy was obtained by a row of 12, 55 gallon oil drums on each side of the barge. Drums were placed at right angles to the current to provide an additional lifting effect. To keep the front of the barge from diving into the water at higher velocities and provide a planing effect, a pontoon was placed at the upstream end of each row of barrels. The pontoons and cross-framework were bolted together. Two-inch plank-ing was used for decking the downstream end and two sides of the barge. The upstream end of the barge was provided with an opening 7 feet wide and 17 feet long through which the trap was lowered into fishing position.

Five-ton winches with 500 feet of 7/16-inch steel cable on the drum were placed on a steel stand about 1/3 of the way back on each side of the barge and in line with the pontoons. The cables passed through swivel blocks on plates on the front corners of the barge and were secured to pilings of the bridge approximately 150 yards apart. The barge could be shifted across or up and down the river by manipulation of the winches.

For the safety of the men working the barge, a steel guard rail approximately 3 feet high encircled the entire structure. A small shelter was later erected on one corner of the barge for protection from the weather.

The downstream trap used on the barge was 16 feet long, 6 feet wide and 6 feet deep at the mouth. An inclined plane covered with heavy duty $\frac{1}{4}$ -inch mesh hardware cloth led from the bottom of the trap's mouth to a live box on the downstream end of the trap which collected the fish. Steel angle iron was used for framework and bracing of the trap. An earlier trap made of aluminum tubing did not prove to be satisfactorily strong and was replaced with the heavier trap.

The trap was lowered into the water by winches--two on each end and each set operated on a common shaft. Steel rope was used on the winches and was attached to the corners of the trap with shackles. The downstream end of the trap was rigged with two heavy steel rollers which moved up or down on an angle-iron track. A head of water was built up just forward of the live box by the velocity of the water moving up the inclined plane. An average water area of 30 square feet was strained by the traps. Plate 3 shows the trap out of the water and Plate 4 shows it in fishing position.

The trap was fished in water velocities ranging from approximately 3.4 to 8 feet a second. The higher velocities were selected to retain larger downstream migrants, the rule-of-thumb for small fish being that one foot a second velocity per inch of fish is needed to trap migrants. The migrants ranged up to 8 inches or more in length. Emphasis was attached to trapping larger migrants (steelhead) since earlier studies indicated they were either less abundant or more difficult to catch than chinook migrants. Velocity measurements were taken by timing floats past the barge with a stop watch.

The barge was fished in 8-hour shifts altered throughout the month so as to cover every hour of the day. The trap was raised and catch removed each hour. A catch record was kept each hour and readings were taken of water temperature, water velocity and turbidity. Other data included on the records were the weather, location of the barge by its distance from the shore and the stream depth at the throat of the trap. All fish caught were recorded by number of each species and fork lengths in mm. of the game fish were taken with a measuring trough (Plate 5). The fish were then released.

Before being lowered back into the water after each hourly check, the screens were cleaned. To do this the downstream end of the trap was lowered slightly into the water creating a back current on the inclined plane and carrying most of the debris out through the throat. Brushes were used for assisting in the cleaning.

Kray-Meekin Traps:

For trapping downstream migrants close to shore, floating traps of the Kray-Meekin type developed by the Washington Department of Fisheries were used (Plate 6). These traps were approximately 7 feet long, 3 feet wide, and two feet high with a live box located on the downstream end into which the migrants fall. Wire screen of $\frac{1}{4}$ -inch mesh was used to cover the sides and inclined plane of the traps with $\frac{1}{8}$ -inch mesh

on the live box. The traps were fished on both shores of the river and were fastened by a lead cable to cables strung between the steel pilings of the interstate bridge. A pontoon on each side provided buoyancy. Game fish caught were enumerated and measured for fork length as on the barge. Velocities fished ranged from two to five feet a second with an average of three. These traps were checked less frequently than the barge trap.

FINDINGS AND DISCUSSION

Chinook Salmon Downstream Migration:

Catch and correlation of catch with water flow and temperature.

Largest catches of downstream chinook migrant occurred during April and May in 1957, and March, April, May, and June in 1958, as indicated in Tables 1 and 2. The lower catches of chinook in April and June of 1957 is attributed to the fact that the barge was not put into operation until April 10 of that year and was out of operation from May 29 to June 11 as well as to yearly fluctuations in numbers.

The highest single monthly catch in both years occurred in May. When 301 chinook were caught in 1957, and 946 in 1958 on the barge trap. An additional 619 chinook were caught in Kray-Meekin traps in May, 1958, making a total of 1,565 fish. Kray Meekin traps were not used in 1957.

Of all chinook caught during the period July 1, 1957 to June 29, 1958, 99.29 per cent were caught during the months of March, April, May, and June as indicated in Table 3 and 67 per cent of these were caught in May, 1958.

Largest catches of seaward migrant chinook salmon in both 1957 and 1958 occurred during the spring floods and were correlated with the rise in water temperature and flow of the Snake River for April, May, and June as indicated in Figures 2 and 3. The peak of the migration occurred approximately two weeks prior to the peak of the spring flood in 1957 and approximately coincided with the peak of the spring flood in 1958.

In 1957, chinook passed through the area in greatest numbers as the mean weekly water temperature rose from 52° to 62°F. with the peak of the migration occurring as the mean weekly water temperature was approximately 55 degrees. In 1958, the heaviest migrations occurred as the water temperature rose from 50° to 61°F. with the peak of the migration occurring as the water temperature reached 56°F.

In May of 1956 peak migrations of seaward bound chinook salmon occurred as the water temperatures reached 56.5°F. at Pleasant Valley, about 80 miles downstream from Brownlee Dam.

Hourly Movements of Downstream Chinook Salmon Migrants:

Substantial numbers of chinook salmon were found to be passing Brownlee Dam at all hours of the day during the migration. However, certain periods exhibited peak movements.

During May, 1957, the largest numbers of chinook parr caught per hour were taken between 1 and 2 P. M., 8 to 9 A. M., 3 to 4 P. M., 7 to 8 P. M., 4 to 5 P. M., and 11 A. M., to 12 P. M., in that order as shown in Figure 3 and Table 4.

In May, 1958, the morning and afternoon rate of catch corresponded very closely with those of May, 1957, as shown in Tables 4 and 5 and Figure 4. The hour from 8 to 9 A. M. showed the highest single movement of fish with 1-2 PM. second. Peak of the early morning movement in May, 1958, occurred between 4 A. M. and 7 A. M.

Hourly catches of chinook in May and June 1958, were quite similar as shown in Figure 5 and Tables 5 and 6, but neither of these months showed much similarity to April (Table 7 and Figure 5). A possible explanation could be the differences in water temperature. Steelhead and Chinook peak hourly catches in April, 1958, were similar (Figure 6 and Tables 7 and 8).

The smallest numbers of downstream migrants trapped were in the hours 6 P. M. to 1 A. M. in May, 1958, and from 4 P. M. to 7 P. M. and 9 P. M. to 3 A. M. in June, 1958.

Length Frequencies of Downstream Migrating Chinook:

In May of both 1957 and 1958 the fork-length frequency mode for the chinook downstream migrants was in the 65 to 69 mm. group as shown in Figure 7 and Tables 9 and 10.

Length frequency means in April, May, and June of 1958, were 66.3 mm, 67.9 mm, and 84.8 mm. respectively, Figure 8.

Seventy-nine chinook fry ranging in length from 30 to 49 mm, were caught in April and May of 1958. Twenty-two of these fry were caught in April and 57 were caught during May. No fry of the above named lengths were caught in June, 1958. Some of the fry were evidently offspring of fish that had spawned a short distance above the trapping site at the bridge but below Brownlee dam.

Estimations of Numbers of Downstream Migrating Chinook Salmon:

Estimations were made of the total number of downstream migrating chinook salmon and steelhead passing Brownlee Dam by month and day as indicated by barge trap catches. These are shown in Figure 9 and Table 11.

The formula used to compute the estimated total numbers of fish is shown below. It is assumed that downstream migrants were evenly distributed throughout the river and that the periods fished were representative of daily distribution of fish.

Total	RIVER FLOW IN C. F. S.		
Number of	AREA STRAINED BY TRAP X WATER VELOCITY X HRS. FISHED		No.
downstream=	(30 sq. ft.)		caught
migrants	24		

The estimated total numbers of downstream migrant Chinooks passing Brownlee Dam from July 1, 1957, to June 29, 1958, were 715,751. Total estimates for May, 1958, the month of the largest catches, were 473,000. The highest daily estimate was approximately 80,000.

Steelhead Trout Downstream Migrations:

Catch and correlation of catch with water flow and temperature.

April, 1958, was the peak month for steelhead downstream migrant catches. No steelhead catches of any significance were made in April, 1957, possibly for the reasons explained above. May of 1958 was the month in which the second highest catches were made (Table 2).

In 1958 the downstream migration of steelhead started the last week in March and continued until mid June. Table 3 shows that 90.9 per cent of the total catch of steelhead was made during these four months with 3.03 per cent of these being caught in March, 50.5 per cent in April, 26.26 per cent in May, and 11.1 per cent in June. A total of 90 steelhead were caught in the barge trap from March through June of 1958 and an additional 20 were caught in Kray-Meekin traps.

Largest numbers of steelhead downstream migrants were caught at the beginning of and in the first peak of the spring flood as illustrated in Figure 3. Peak catch of steelhead preceded the peak catch of chinook by approximately 4 weeks in 1958.

Steelhead trout migrated past Brownlee in greatest numbers in 1958 as the mean weekly water temperature rose from 50° to 56°F. and the peak of the migration occurred when the mean weekly water temperature was approximately 52°F.

Hourly Movements of Downstream Migrating Steelhead:

The rate of catch of steelhead coincided very closely with that for the chinook during April, 1958, Figure 6 and Table 7 and 8. Largest catches were made from 9 to 10 A. M., 2 to 3 P. M., and from 5 to 6 P. M.

Hours of little or no movement were from 8 to 9 A. M., 1 to 2 P. M., and 3 to 4 P. M. and 8 P. M. to 2 A. M., as shown by trap catches.

Length Frequencies of Downstream Migrating Steelhead:

The mean fork-length of steelhead caught during April and May of 1958, was 165.2 mm. as shown in Figure 10 and Table 12. They ranged in length from 105 mm. to 249 mm. Slightly over 90 per cent of the steelhead caught during the two months were in the range of 130 to 204 mm.

Estimation of Numbers of Downstream Migrating Steelhead:

The same formula was used in computing estimates of total numbers of steelhead passing Brownlee Dam. An estimated 77,405 steelhead passed Brownlee from July 1, 1957-June 29, 1958. April, 1958, the peak month, showed an estimated total of 42,438.

Seasonal Dispersal of Chinook Salmon and Steelhead Trout:

Powder River and Eagle Creek

From October, 1957, through January, 1958, studies were made of fish movements in Powder River and Eagle Creek, located approximately 12 miles upstream from Brownlee Dam Oregon. Eagle Creek is a tributary to the Powder River and is an excellent salmon and steelhead spawning stream. Purpose of the study was to determine if chinook salmon and steelhead trout pass from Eagle Creek into the Powder River and on down the Snake past Brownlee Dam during fall or winter months in significant numbers.

Check list and relative abundance of trapped fish.

The common and scientific names of fishes caught in the Snake River at Brownlee Dam in downstream migrant traps, and their relative abundance as indicated by numbers taken, are as follows:

Family	Common Name	Scientific Name	Relative Abundance	
Migratory Species				
Salmon and trout (dwnstrm. migrants)	chinook salmon	<u>Oncorhynchus tshawytscha</u>	95.19%	
	steelhead trout	<u>Salma gairdnerii</u>	4.81%	
		Total	100.00%	
Lamprey	pacific lamprey	<u>Entosphenus tridentatus</u> (245)		
Resident Game Species			% Res. Game Fish by-species	% Resident Fish by species
Catfish	black bullhead	<u>Ameiurus melas</u>	4.91	.32
	channel catfish	<u>Ictalurus punctatus</u>	52.06	3.40
Sunfish	black crappie	<u>Pomoxis nigro-maculatus</u>	15.09	.99
	bluegill	<u>Lepomis macrochirus</u>	2.64	.17
	largemouth-bass	<u>Micropterus salmoides</u>	4.15	.27
	smallmouth bass	<u>Micropterus-dolomieu</u>	16.23	1.06
Whitefish	R.M. whitefish	<u>Prosopium williamsoni</u>	4.91	.32
			100.00%	6.53%
				Sub-total
			% Res. non-game fish by species	
Resident Non-game species				
Catfish	tad pole-mad tom	<u>Schilbeodes mollis</u>	.08	.07
Minnow	carp	<u>Cyprinus carpio</u>	3.28	3.06
	chiselmouth	<u>Acrocheilus alutaceus</u>	36.62	34.22
	col. river chub	<u>Mylocheilus cuarinus</u> ,	.18	.17
	long-nosed dace	<u>Rhinichthys cataractae dulcis</u>	4.65	4.35
	redside shiner	<u>Richardsonius balteatus</u>	13.87	12.96
	squawfish	<u>Ptychocheilus aregonensis</u>	20.85	19.48
Sculpin	sculpin	<u>Cottus sp.</u>	.05	.05
Sucker	coarse scale sucker	<u>Catostomus macrocheilus</u>	1.61	1.50
	fine scale sucker	<u>Catostomus columbianus</u>	18.81	17.58
			100.00%	93.44%
				Subtotal
				Total-100%

The Oregon Game Department maintains a series of by-pass traps on their rotary-drum screens in the diversions from Eagle Creek. All downstream migrants caught in the traps were marked after anesthetizing for easier handling with an anal fin clip. A total of 13,924 chinook and 4,136 steelhead were marked for a total of 18,060 fish (Table 13). Some fish were tattooed in addition to the anal fin clip.

Floating scoop traps of the Kray-Meekin type were used for recapturing fish. Three traps were used--one at the mouth of Eagle Creek and two near the mouth of the Powder River where it joins the Snake River.

Catch records indicated that the vast majority of fish move at night--from dark until about 1 A. M. Similar movement was noticed of fish moving down Wildhorse River (according to catches at the weir installed there). A rainstorm of any consequence greatly increases the movement of fish down Eagle Creek. This same fact was found true by Oregon Game Department personnel in their by-pass trap operations.

Largest catches of downstream migrants were made when the water temperature was approximately 38°F. but catches were made when the water temperatures were between 36° and 42° F.

A total of 1,054 chinook and 7 steelhead were captured in the scoop traps. Of these 205 chinook and 3 steelhead were marked fish. Table 14 shows the length frequency distribution of fish caught in both the Powder River and Eagle Creek scoop traps.

The study indicates that considerable numbers of the chinook and steelhead fingerlings move downstream into the Powder River and some of these on down the Snake during the fall and winter months. No marked fish were caught off the downstream migrant trapping barge in the winter months and only a small number of unmarked fish as shown in Table 15. However, in a seining operation on February 12, 1958, ½ mile above Homestead, Oregon and 15½ miles downriver from Brownlee Dam, 6 chinook were caught of which 3 had been marked in Eagle Creek. All of these fish were in the same length groups as those caught in Eagle Creek.

A fisheries biologist with the Oregon Game Department, caught two Eagle Creek marked fish in a seining operation at the same location a few days prior to the February 12 operation. No lengths were obtained on those fish but it was stated that they were of approximately the same length as those caught on February 12. In fact they could have been the same fish.

On April 30, 1958, a chinook of 130 mm. marked with the Eagle Creek anal fin clip was caught in a Kray-Meekin trap on the Oregon side of the river at the bridge directly below Brownlee Dam. This fish was undoubtedly a seaward migrant.

The unmarked fish caught off the barge at Brownlee Dam in November, December, 1957, and January, 1958, were also in the same length frequency groupings as the Eagle Creek fish. (Table 15).

No marked steelhead from Eagle Creek were caught in the Snake River. The smaller number of steelhead marked coupled with the fact that they are considerably larger than the chinook and more able to escape the traps is a possible explanation.

Wildhorse River

Catches made at a fish weir installed on Wildhorse River in Idaho show results similar to those of Eagle Creek and the Powder River. Wildhorse River enters the Snake River between Brownlee and Oxbow Dams. Since no provisions are being made to handle the runs of spring chinook salmon and steelhead trout utilizing Wildhorse, a project is underway to transplant these runs to the Weiser River drainage. In January, 1958, a trapping weir was placed in operation on Wildhorse River. All salmon and steelhead downstream migrants have been marked with a ventral fin clip and transplanted to Pine Creek, a tributary of the Weiser River (Figure 1).

To date, 3 marked chinook and 1 marked steelhead from Wildhorse River have been recovered on the barge trap and three marked Wildhorse River chinook in a Kray-Meeke trap at the bridge. The marked chinook were recaptured on March 27, April 10, 18, 23 and 30 and June 10, 1958. The marked Wildhorse steelhead was caught on April 26, 1958.

Catches during Tunnel-Closure:

An interesting facet of the downstream migration pattern is noted during closure of the tunnel at Brownlee dam in May of 1958. The two closure gates (lowered on May 9 about 4 P. M.) each contained a port to allow for minimum flow requirements. As the reservoir elevation increased the catch of downstream migrants decreased until none were being caught. After spill commenced (about 3 P. M., May 13) several days were required for catches to return to their former size. The top of the closure gate ports was at elevation 1784' m.s.l. The flood-port sill is at elevation 1940'. Following is a summary of physical data and catch of salmon and steelhead migrants in the barge trap. The forebay elevation readings were taken at about 8 A. M. each day.

Date	River flow, cfs at Oxbow	Forebay elevation in ft. M.S.L.	Water depth over tunnel ports	Water Depth at flood port sill	Number of fish caught
May 7	32,400				39
8	34,200				25
9	35,800	1846.4	62.4		97
10	9,800	1874.8	90.8		15
11	10,880	1900.7	116.7		1
12	11,960	1919.0	135.0		1
13	11,400	1936.2	152.2		0
14	17,800	1951.3		11.3	19
15	27,100	1957.3		17.3	64
16	33,300	1961.6		21.6	61
17	38,000	1964.8		24.8	59
18	43,300	1966.7		26.7	100

DISCUSSION AND CONCLUSIONS

Largest catches of downstream chinook migrants at Brownlee Dam occurred during March through June in 1958 when 99.29 per cent of the total yearly catch was made. The same general pattern of migration was found in 1957 during the periods that were trapped. The highest single monthly catch in both 1957 and 1958 occurred in May.

In both 1957 and 1958 the largest catches of seaward bound chinook salmon occurred during the spring floods and were correlated with the rise in water temperature and flow of the Snake River from April through June.

The mean weekly water temperature of the Snake River was nearly the same in both 1957 and 1958--from approximately 50° to 62°F° when downstream migrating chinook passed through in greatest numbers. Peak of the migration occurred at 55°F. in 1957 and 56° in 1958.

Substantial numbers of chinook salmon passed Brownlee Dam at all hours of the day during the migration. Certain peak periods of movement were noted. Hourly catches in May, 1957 corresponded very closely with those of 1958 and hourly catches of May and June, 1958 were quite similar.

In May of both 1957 and 1958 the fork length frequency mode of chinook downstream migrants was in the 65 to 69 mm. group. Seventy-nine Chinook fry from 30 to 49 mm. were caught in April and May of 1958.

An estimated 715,751 downstream chinook migrants passed Brownlee Dam from July 1, 1957 to June 29, 1958.

Greatest numbers of steelhead downstream migrants were caught in April, 1958. The month of April and May were only partially covered by trapping in 1957. Second highest catches were made in May of 1958. Steelhead downstream migration started the last week in March of 1958 and continued until mid June. During this period 90.9 per cent of the total catch was made.

In 1958 the largest numbers of steelhead were caught at the beginning of and peak of the first flood as the mean weekly water temperature rose from 50° to 56°F. Peak of the steelhead migration occurred as mean weekly water temperature was approximately 52°F.

The rate of catch of steelhead migrants coincided very closely with that of chinook for April, 1958.

Steelhead caught during April and May of 1958 had a mean fork length of 165.2 mm. Over 90 per cent were in the length range from 130 to 204 mm.

An estimated 77,405 steelhead downstream migrants passed Brownlee Dam from July 1, 1957 to June 29, 1958.

A study of winter movements of chinook and steelhead fingerlings in the Powder River and Eagle Creek of Oregon and of Wildhorse River in Idaho indicate that the vast majority of the fish move at night--from dark until 1 A. M. and are influenced by weather.

The study indicates that chinook and steelhead move out of Eagle Creek into Powder River and some of these from Powder River on down the Snake during the fall and winter months. The movement has no set pattern. It might be described as a dispersal due to weather conditions or for feeding.

During closure of the tunnel gates at Brownlee fish catches dropped as the depth of water increased over the tunnel gate ports. Salmon and steelhead migrants apparently did not sound to depths greater than 100 feet to leave the reservoir.

RECOMMENDATIONS

The following recommendations are made for the operation of the downstream migrant facilities at Brownlee Dam:

1. Net. -

The net should be maintained as a fish-tight barrier at all times to prevent passage of fish to the forebay downstream. This passage includes anadromous as well as resident species of game fish.

Major repair and maintenance work that requires removal of portions of the net should be limited, as far as possible, to those months of no migration and of little resident fish activity.

2. Artificial Outlets -

A. During months of major downstream migration - March, April, May and June - in other months when anadromous species are migrating, all three artificial outlets should be operated on a 24-hour basis.

When maintenance or repair work is necessary, it is suggested that such work be done during those hours of low movement. Prior to impoundment, these hours were approximately from 9:00 P.M. to 2:00 A.M. Whenever it is necessary to shut down the center unit - both shore units should be operated. Whenever it is necessary to shut down either shore unit, the center unit should be operated.

B. During periods of minor migration - either the two shore units or the center unit should operate during 24 hours of the day.

C. During months of no migration - only one unit need be operated on a sampling basis at any one time. When sampling indicates the movement of significant numbers of downstream-migrant salmon and steelhead, Schedule B should be placed in operation.

The possibility of changes in the migration pattern of chinook salmon and steelhead trout caused by their passage through Brownlee reservoir is recognized. Observations should be continued to determine the extent and nature of these changes should they occur; and the recommended operating procedures should be varied accordingly.

It is recommended that the use of light for attraction or repulsion of fish be explored fully. Care should be exercised on the barges so that migrants are not repelled from the entrances. Use of light intensities which will attract fish to the entrances is encouraged, as is also the use of intensities which will repel fish from areas where they might find egress past the net.

Table 1. Comparison by species of April=June 1957 catch with April-June, 1958 catch on trapping barge,
Brownlee Dam.*

	APRIL		MAY		JUNE		TOT. BY SP		% OF TOTAL BY SPECIES		% OF GAME FISH BY SPEC.		OF RES. FISH BY. SP		
SPECIES	57	58	57	58	57	58	57	58	57	58	57	58	57	58	
Chinook salmon		4	160	301	946	2	282	307	1,388	35.86	74.87	86.72	93.60		
Steelhead		1	50	17	26		11	18	87	2.10	4.69	5.08	5.87		
Channel Catfish			1	1	1			1	2	.12	.11	.28	.13	.19	.67
Rocky Mtn. Whitefish						6	1	6	1	.70	.05	1.69	.07	1.16	.34
Black Bullhead		1		2	1			3	1	.35	.05	.85	.07	.58	.34
Black Crappie			1	5	1	5		10	2	1.17	.11	2.82	.13	1.93	.67
Smallmouth Bass				1	2	1		2	2	.23	.11	.56	.13	.39	.67
Largemouth Bass						7		7		.82	.56	1.98		1.35	
Tot. Game Fish	6	212	327	977	21	294	354	1,483	% OF NON-GAME FISH BY SPECIES						
Fine scale Suckers	1	20	12	62	34	9	47	91	5.49	4.91	9.36	24.53	9.07	30.54	
Coarse scale Suckers			3		23		26		3.04		5.18		5.02		
Carp		6	8	4	92		100	10	11.68	.54	19.92	2.70	19.31	3.36	
Chiselmouth	12	30	100	36	86	3	198	69	23.13	3.72	39.44	18.60	38.22	23.15	
Red sided Shiner	11	4	19	9	25	5	55	18	6.43	.97	10.96	4.85	10.62	6.04	
Squawfish	8	4	28	4	25	3	61	11	7.13	.59	12.15	2.96	11.78	3.69	
Lamprey		10	1	57	12	14	13	81	1.52	4.37	2.59	21.83			
Long nosed Dace		3	2	22		65	2	90	.23	4.85	.40	24.26	.39	30.20	
Madtom				1				1		.05		.07		.34	
Total Non-Game Fish	32	77	173	195	297	99	502	371					Total Res Fish Caught		
Total All Spec. Fish	38	289	500	1,172	318	393	856	1,854					518	298	
Monthly Mean Dis. Snake R.															
in Sec. Ft.	35,750	37,590	50,770	35,590	29,140	28,300									

* Barge trap was placed in operation April 109 1957. Trap was out of operation from May 28, 1957=June 11, 1958.

Table 2. Total catches, all species, on downstream migrant trapping barge, Brownlee Dam, by species and month, July 1, 1957-June 29, 1958.

SPECIES	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.
Chinook salmon			1		3		4	2
Steelhead	2			1	2		2	2
Channel Catfish		69	8	9	12	7	14	4
Rocky Mtn. Whitefish		5	1					
Bluegill		3	3					
Black Bullhead	1	2	2		1			1
Black Crappie	1	1	14	1	2		8	
Smallmouth Bass		1	20	12	1			1
Largemouth Bass	2	1	1					
Tot. Game Fish	6	82	50	23	21	7	28	10
Fine scale Suckers	161	117	116	21	7	4	1.6	21
Coarse scale Suckers	5	21	8				1	
Carp	6	6		1				
Chiselmouth	39	193	430	73	82	4	51	117
Red sided shiner	53	172	173	11	6		6	
Squawfish	13	358	220	76	19	1	6	4
Lamprey	21	24	8	1	5		39	43
Long nosed Dace	18	39	19					
C. R. Chub		5	1					
Sculpin		1						
Madtom								1
Total Non-Game Fish	316	936	975	183	119	9	119	186
Total All Species Fish	322	1,018	1,025	206	140	16	147	196
Monthly Mean Disch. Snake R. in Sec. ft.	11,580	11,700	13,950	16,050	14,190	14,850	14,880	25,410

Table 2. (Continued).

MARCH	APRIL	MAY	JUNE,	Total by Spec.	% of Tot. by Spec.	% of Game Fish by spec.	% of Res. Fish by spec.
14	160	946	282	1,412	27.23	81.01	
3	50	26	11	99	1.91	5.68	
8	1	1		133	2.57	7.63	3.86
			1	7	.14	.40	.20
1				7	.14	.44	.20
2		1		10	.19	.57	.29
1	1	1		30	.58	1.72	.87
4		2		41	.79	2.35	1.19
				4	.07	.23	.12
33	212	977	294	1,743		% Non-Game Fish By Spec.	
100	20	62	9	654	12.61	19.00	19.00
				35	.68	1.02	1.02
	6	4		23	.44	.67	.67
103	30	36	3	1,161	22.40	33.73	33.73
3	4	9	5	442	8.52	12.84	12.84
9	4	4	3	717	13.83	20.83	20.83
10	10	57	14	232	4.47	6.74	
2	3	22	65	168	3.24	4.88	4.88
1				7	.14	.20	.20
				1	.02	.03	.03
		1		2	.04	.06	.06
228	77	195	99	3,442		Tot. Res. Fish Caught	
261	289	1,172	393	5,185			3,442
24,950	37,590	35,590	28,300				

Table 3. Percentages of chinook salmon and steelhead downstream migrants caught by month off downstream migrant trapping barge at Brownlee Dam, July 1, 1957 - June 29, 1958.

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	Total
Chinook	0	0	.07	0	.21	0	.28	.14	.99	11.33	67.0	19.97	100.00
99.29													
Steelhead	0	0	0	1.01	2.02	0	2.02	2.02	3.03	50.5	26.26	11.11	100.00
90.90													

Table 4. Hourly Movement of 301 Chinook Salmon Downstream Migrants As Indicated By Trapping Success, May, 1957. *

Time Period	No. Traps Checks	Number Checks Parr Were Caught	Number Caught Per Hour	Catch Per Hour
8AM-9AM	2	2	6	3.00
9AM-10AM	14	10	30	2.14
10AM-11AM	13	12	34	3.62.
11AM-12PM	12	10	33	2.75
12PM-1PM	8	6	18	2.25
1PM.- 2PM	10	10	52	5.20
2PM-3PM	14	11	37	2.64
3PM-4PM	14	11	42	3.00
4PM-5PM	11	10	32	2.91
5PM-6PM	3	3	5	1.67
6PM-7PM	2	1	4	2.00
7PM-8PM	2	2	6	3.00
8PM-9PM	1	0	0	0.00

* Fish caught before half hour included in that hour.
Fish caught after half hour included in following hour.

Table 5. Hourly Movement of 946 Downstream Chinook Migrants
As Indicated by Trapping Success, May 1958.

Time Period	No. Traps Checks	Number Checks Parr Were Caught	Number Caught Per Hour	Catch Per Hour
8AM-9AM	10	9	94	9.40
9AM-10AM	18	15	91	6.07
10AM-11AM	17	13	102	6.00
11AM-12PM	16	13	115	7.19
12PM-1PM	7	5	44	6.29
1PM.- 2PM	14	10	104	7.43
2PM-3PM	17	13	120	7.06
3PM-4PM	18	12	102	5.67
4PM-5PM	10	9	61	6.10
5PM-6PM	6	4	30	4.00
6PM-7PM	1	1	2	2.00
7PM-8PM	1	1	2	2.00
8PM-9PM	1	1	1	1.00
9PM-10PM	1	1	2	2.00
10PM-11PM	1	1	4	4.00
11PM-12AM	1	1	1	1.00
12AM-1AM	2	2	3	1.50
1AM-2AM	2	2	10	5.00
2AM-3AM	3	3	11	3.67
3AM-4AM	5	5	23	4.60
4AM-5AM	2	2	10	5.00
5AM-6AM	2	1	2	1.00
6AM-7AM	1	1	6	6.00
7AM-8AM	1	1	2	2.00

Table 6. Hourly Movement of 282 Downstream Chinook Migrants
As Indicated by Trapping Success, June, 1958.

Time Period	No. Traps Checks	Number Checks Parr Were Caught	Number Caught Per Hour	Catch Per Hour
8AM-9AM	10	6	29	2.90
9AM-10AM	8	5	16	2.00
10AM-11AM	15	6	31	2.07
11AM-12PM	11	6	16	1.45
12PM-1PM	10	5	12	1.20
1PM.- 2PM	20	9	27	1.35
2PM-3PM	20	10	27	1.35
3PM-4PM	22	14	37	1.68
4PM-5PM	13	4	18	1.38
5PM-6PM	3	1	1	0.33
6PM-7PM	4	2	4	1.00
7PM-8PM	5	3	10	2.00
8PM-9PM	5	4	17	3.40
9PM-10PM	2	1	2	1.00
10PM-11PM	2	1	2	1.00
11PM-12AM	3	2	3	1.00
12AM-1AM	1	0	0	0
1AM-2AM	2	0	0	0
2AM-3AM	1	1	1	1.00
3AM-4AM	2	2	5	2.50
4AM-5AM	1	1	1	1.00
5AM-6AM	1	0	0	0
6AM-7AM	2	1	4	2.00
7AM-8AM	9	7	19	2.11

Table 7. Hourly Movement of 160 Downstream Chinook Migrants
As Indicated By Trapping Success, April, 1958.

Time Period	No. Traps Checks	Number Checks Parr Were Caught	Number Caught Per Hour	Catch Per Hour
8AM-9AM	7	6	8	1.14
9AM-10AM	10	8	16	1.60
10AM-11AM	12	8	17	1.17
11AM-12PM	11	6	8	.73
12PM-1PM	9	8	15	1.66
1PM.- 2PM	11	7	18	1.64
2PM-3PM	13	8	22	1.69
3PM-4PM	13	11	34	2.62
4PM-5PM	10	7	15	1.50
5PM-6PM	2	2	7	3.50
6PM-7PM	1	1	1	1.00
7PM-8PM	1	1	2	2.00
8PM-9PM	2			0
11PM-12AM	1			0
1AM-2AM	1			0
2AM-3AM	1			0

- No trap checks during hours omitted.

Table 8. Hourly Movement of 50 Downstream Steelhead Migrants
As Indicated By Trapping Success, April, 1958.*

Time Period	No. Traps Checks	Number Checks Parr Were Caught	Number Caught Per Hour	Catch Per Hour
8AM-9AM	7	2	2	.29
9AM-10AM	10	2	6	.60
10AM-11AM	12	4	6	.50
11AM-12PM	11	6	7	.58
12PM-1PM	9	2	3	.33
1PM.- 2PM	11	1	1	.10
2PM-3PM	13	7	11	.85
3PM-4PM	13	3	3	.23
4PM-5PM	10	5	6	.60
5PM-6PM	2	2	3	1.50
6PM-7PM	1	0	0	0
7PM-8PM	1	1	1	1.00
8PM-9PM	2	0	0	0
11PM-12AM	1	0	0	0
1AM-2AM	1	0	0	0
2AM-3AM	1	1	1	1.00

* No trapping checks during hours omitted.

Table 9. Length frequency distribution of 301 chinook salmon downstream migrants caught during May, 1957, at Brownlee Dam.

Length in mm.	n.	Length in mm.	n.
50-54	3	90-94	1
55-59	24	95-99	1
60-64	47	100-104	0
65-69	88	105-109	1
70-74	64	110-114	0
75-79	51	115-119	0
80-84	13	120-124	1
85-89	7		

Table 10. Length frequency distribution of 2,171 chinook salmon downstream migrants caught, during April, May, and June, 1958, at Brownlee Dam.

<u>Fork Length in mm.</u>	<u>Number of fish</u>		
	<u>April</u>	<u>May</u>	<u>June</u>
30-34		2	
35-39		7	
40-44	19	6	
45-49	38	7	
50-54	54	82	1
55-59	90	220	0
60-64	97	281	1
65-69	41	330	2
70-74	31	298	15
75-79	23	202	47
80-84	15	72	90
85-89	8	31	72
90-94	7	9	27
95-99	21	5	17
100-104	31	7	6
105-109	18	4	3
110-114	23	1	0
115-119	8	0	0
120-124		1	1

Table 11. Estimated total number of chinook salmon and steelhead trout downstream migrants passing Brownlee Dam, July 1, 1957 June 29, 1958.

Month	<u>Total Estimates</u>	
	Chinook	Steelhead
July	284	284
August	0	0
September	130	0
October	0	40
November	703	703
December	0	0
January	709	971
February	1,085	1,085
March	12,304	7,414
April	109,456	42,438
May	473,001	22,242
June	118,079	2,228
Total for year	715,751 998,911	77,405 107,052

Table 12. Length frequency distribution of 93 steelhead downstream migrants caught during April and May, 1958, at Brownlee Dam.

Length in mm.	n.	Length in mm.	n.
105-109	1	180-184	4
110-114	1	185-189	3
115-119	0	190-194	3
120-124	1	195-199	6
125-129	0	200-204	3
130-134	3	205-209	0
135-139	3	210-214	2
140-144	3	215-219	0
145-149	11	220-224	1
150-154	10	225-229	0
155-159	5	230-234	1
160-164	5	235-239	0
165-169	9	240-244	0
170-174	9	245-249	1
175-179	8		

Table 13. Eagle Creek Fish Marking Experiment (From O.S.G.C.) October 3 to November 19, 1957.

Screen		Length of operation (in days)	Diverted fish*		Total	Rediverted fish	
			Salmon	Steelhead		Number	Per Cent
9-23	(8 3/4 mi. above mouth of creek)	48	10,845	2,431	13,326	2	
9-7	(6 3/8 mi. above mouth of creek)	16	125	2	127	49	38.6
9-4	(5 3/8 mi. above mouth of creek)	39	1,109	707	1,816	548	30.2
9-6	(5 mi. above mouth of creek)	39	1,689	744	2,433	1,354	55.6
9-1		7	156	202	358	72	20.1
Totals		149	13,924	4,136	18,060	2,025	11.2

* All diverted fish were marked by clipping the anal fin.

Table 14. Length frequency distribution of 871 downstream migrant chinook salmon caught in Kray-Meekin traps during November and December, 1957, in Eagle Creek and the Powder River.

Length in mm.	n.	Length in mm.	n.
65-69	1	100-104	120
70-74	1	105-109	69
75-79	8	110-114	45
80-84	44	115-119	32
85-89	92	120-124	8
90-94	217	125-129	1
95-99	235		

Table 15. Salmon and steelhead caught on downstream migrant trapping barge at Brownlee Dam during October, November, December, 1957, and January, 1958.

	CHINOOK	STEELHEAD
October, 1957	0	1.....144m
November, 1957	3.....95mm 95mm	2.....87mm 141mm
December, 1957	0	0
January, 1958	4107mm 95mm 96mm 109mm	2.....154mm 235mm

Figure 1. Map of Middle Snake River

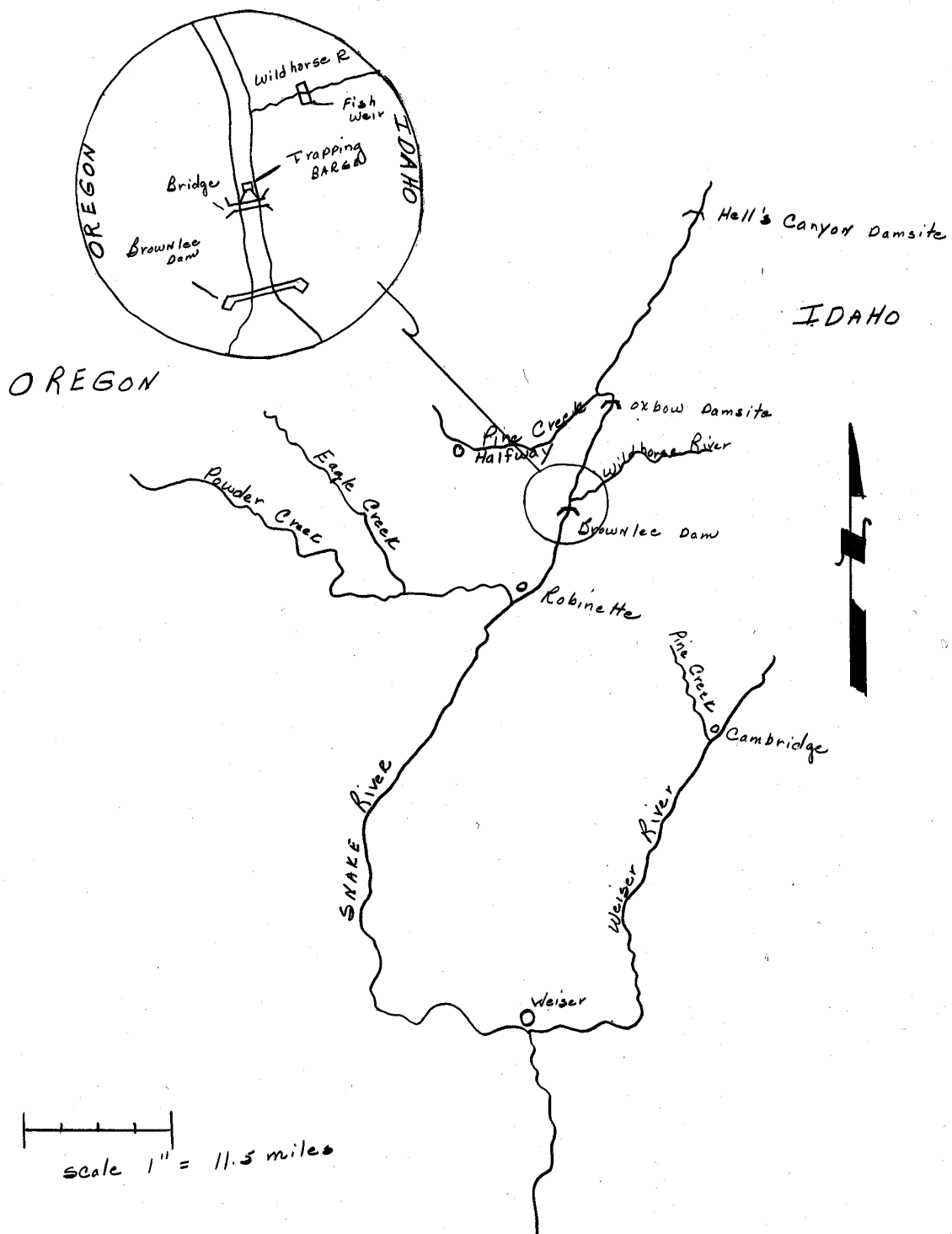


Figure 2. Weekly catch of downstream migrant chinook salmon, weekly mean discharge of Snake River, and weekly mean water temperature, April-June, 1957 on downstream migrant trapping barge, Brownlee Dam.

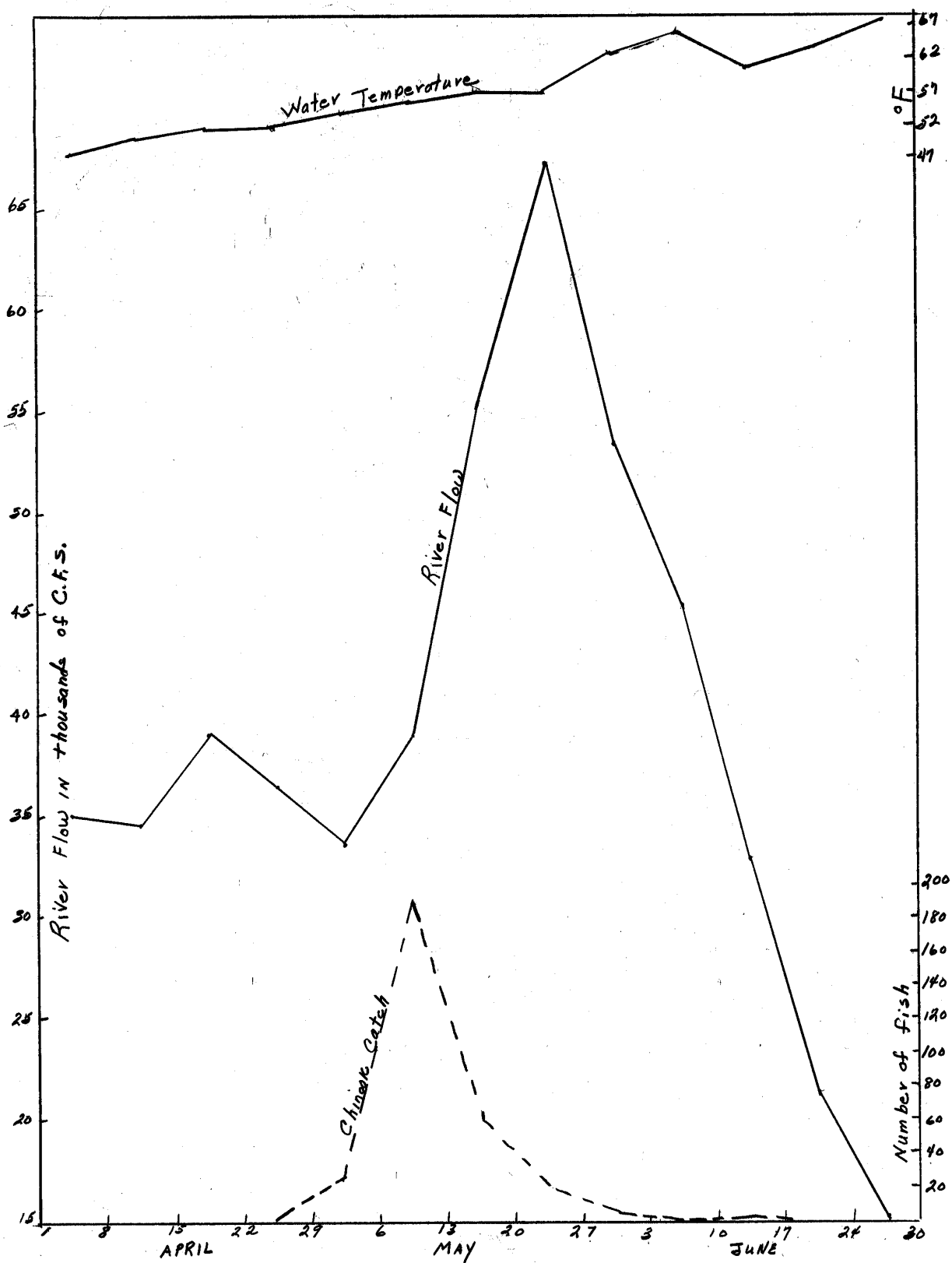


Figure 3.

Weekly catch of downstream chinook salmon and steelhead trout, weekly mean discharge of Snake River and weekly mean water temp., April-June, 1958, on downstream migrant trapping barge, Brownlee Dam.

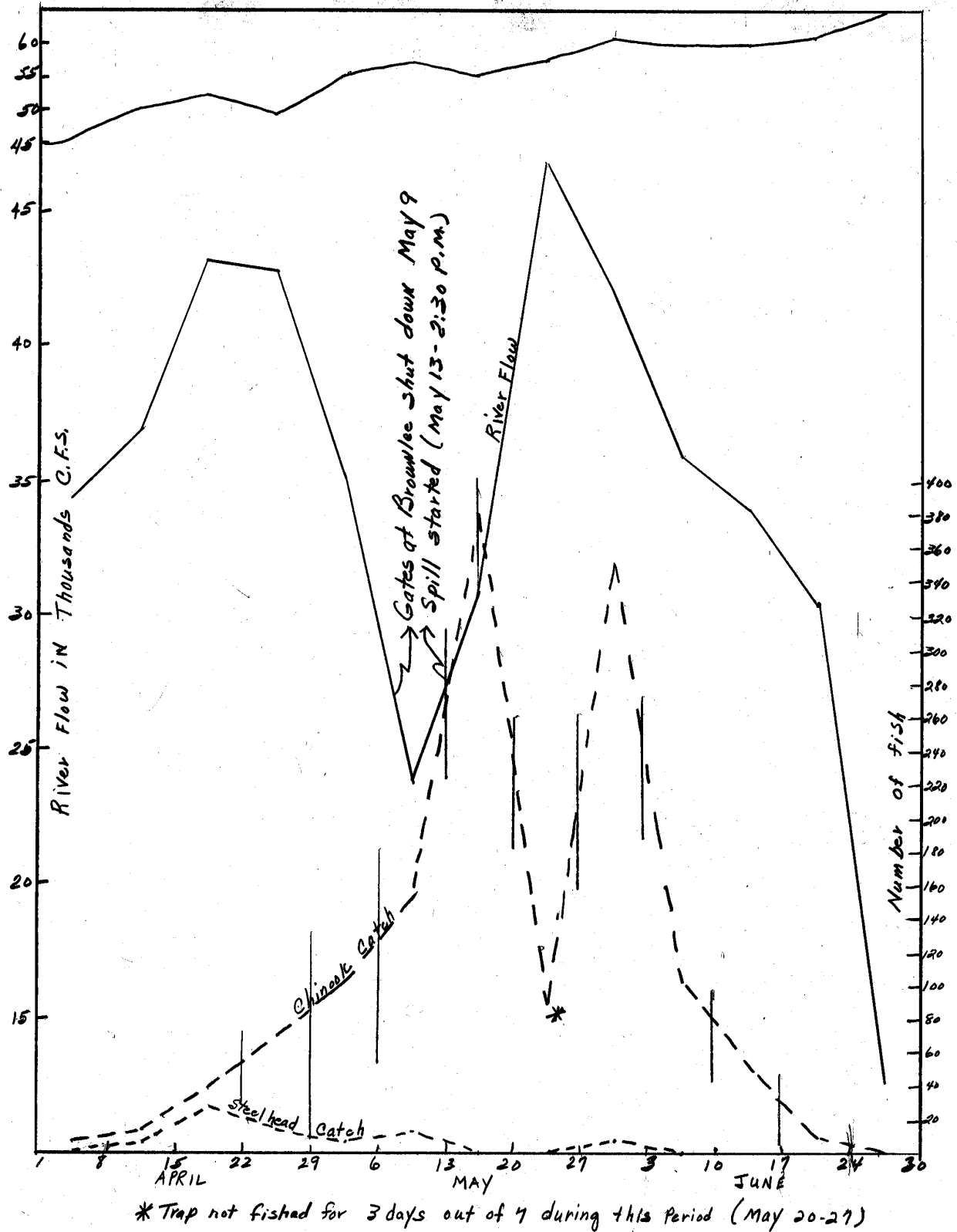


Figure 5. A comparison of hourly movements of chinook salmon downstream Migrants caught during April, May, and June, 1958, at Brown-Lee Dam as indicated by trapping success.

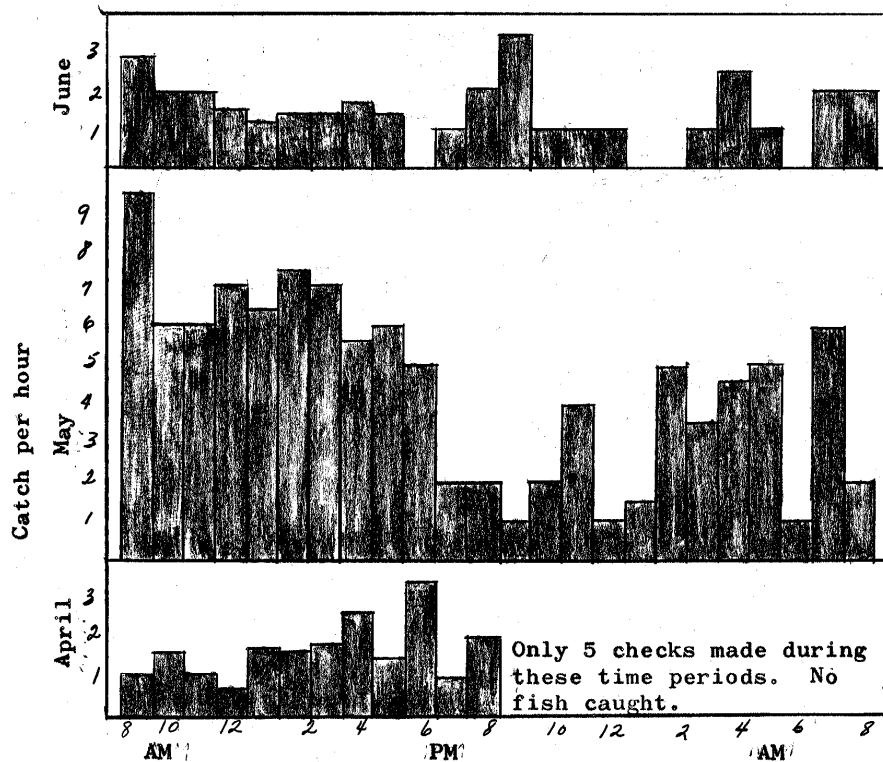


Fig. 6. A comparison of hourly movements of downstream steelhead migrants with chinook migrants April, 1958, as indicated by trapping success.

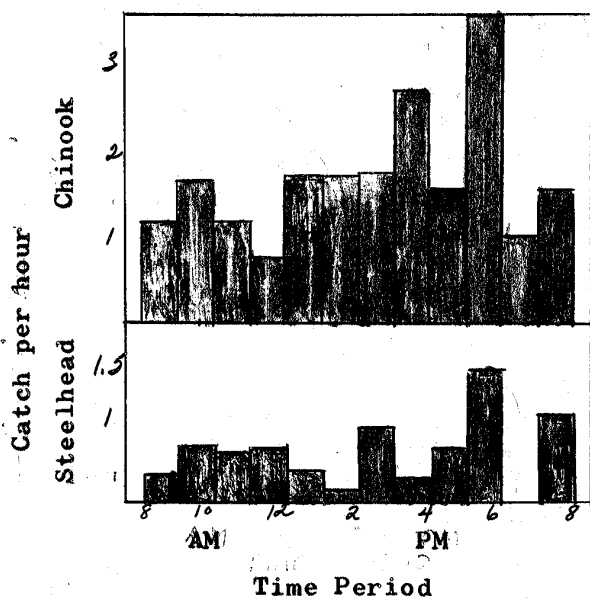


Fig. 4. A comparison of hourly movements of downstream chinook migrants during May, 1957 and May, 1958, as indicated by trapping success.

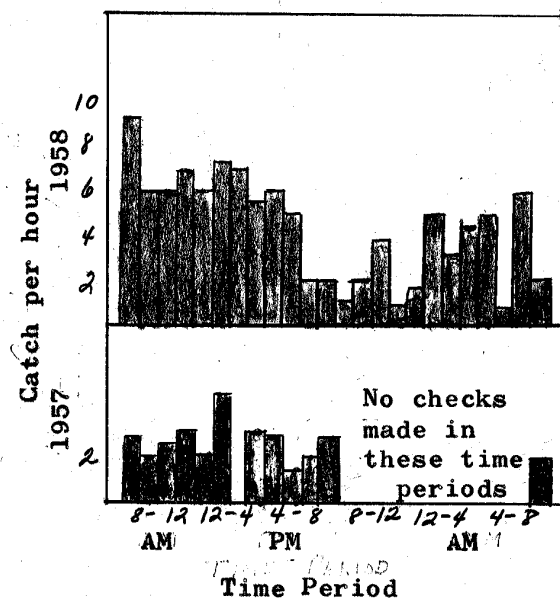


Figure 7. Length frequency distribution of chinook
Salmon downstream migrants caught at Brown-
Lee Dam, May 1957, and May, 1958

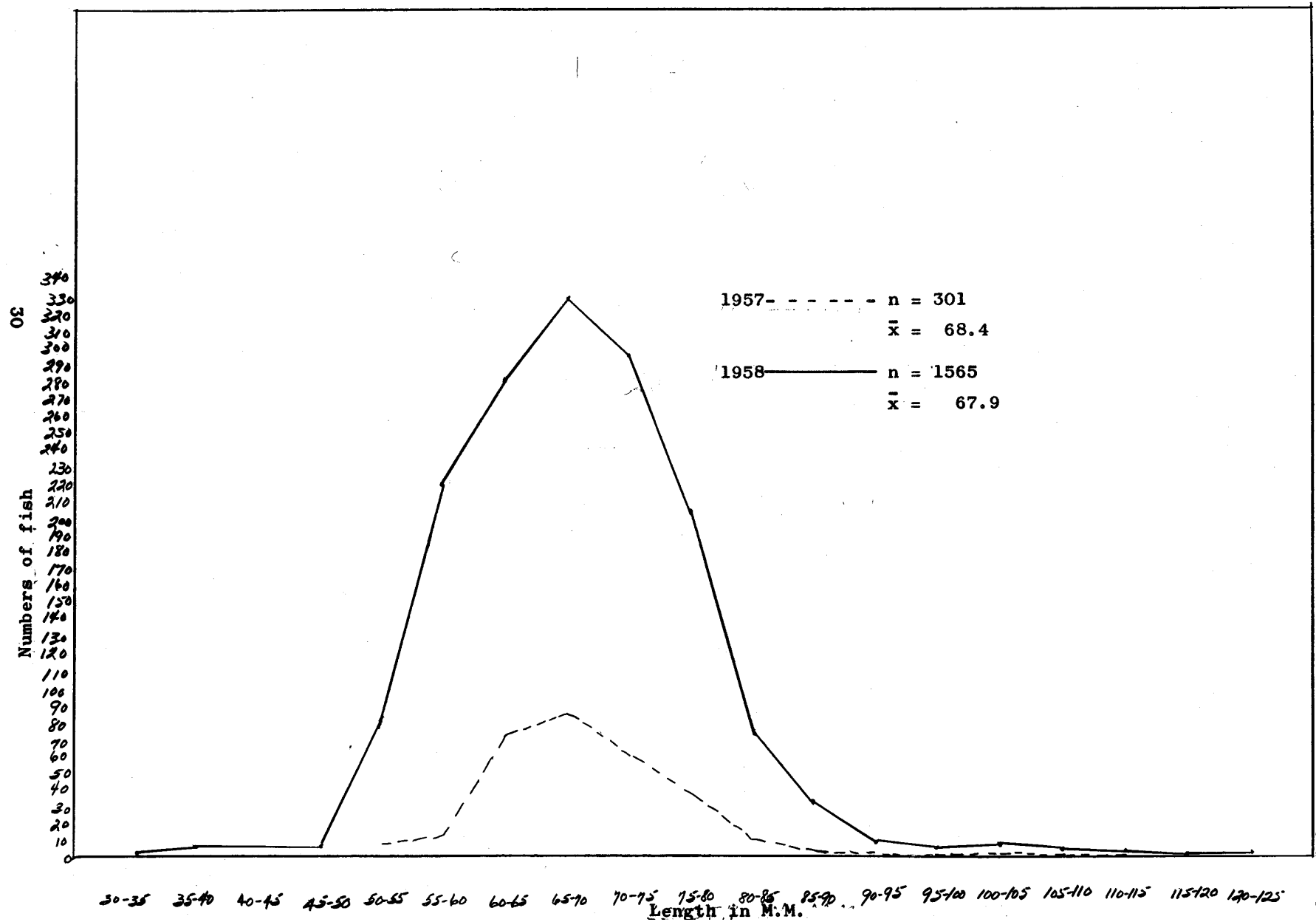
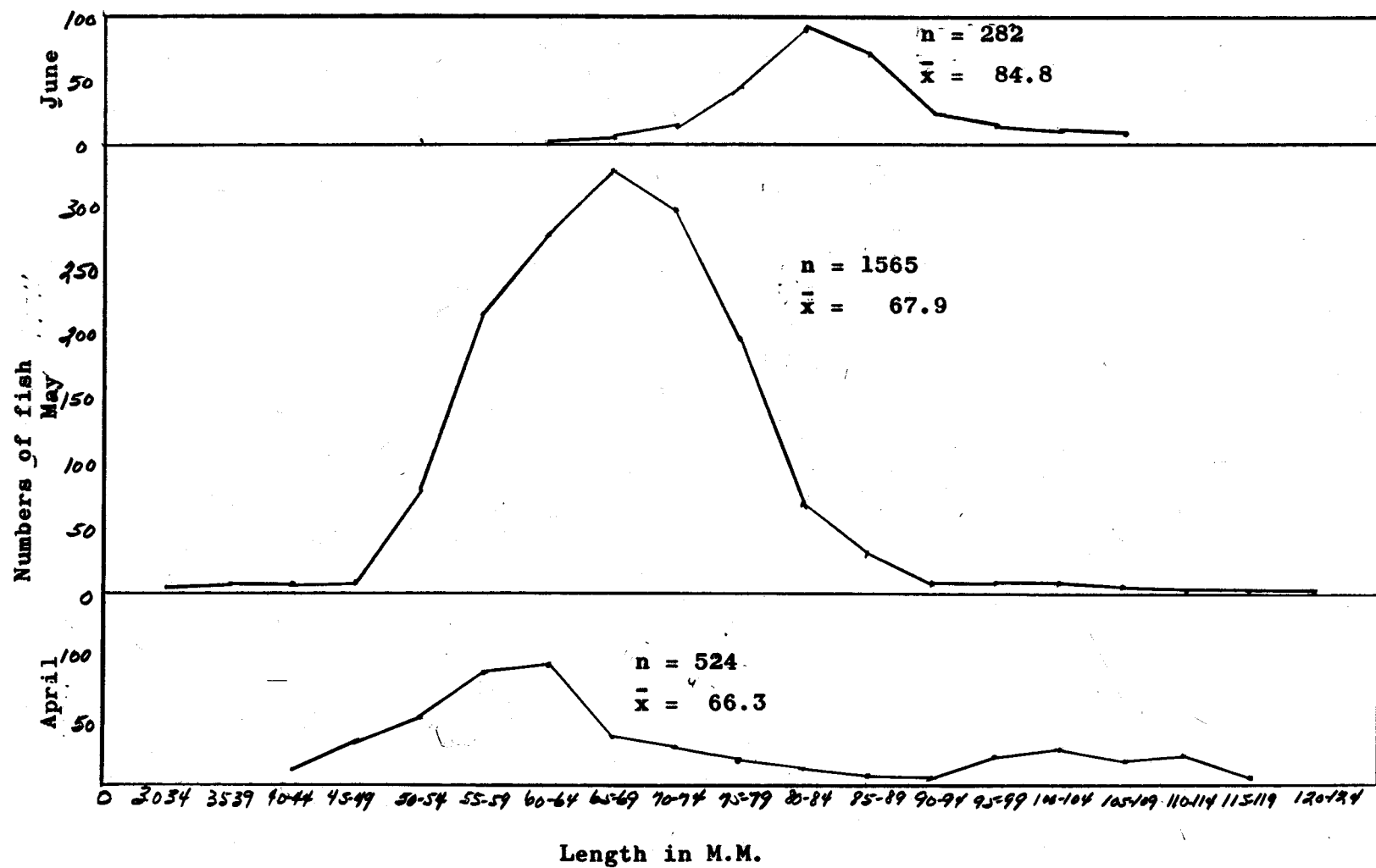


Figure 8. Length frequency distribution of chinook salmon, downstream migrants
Caught at Brownlee Dam, April, May, and June, 1958.



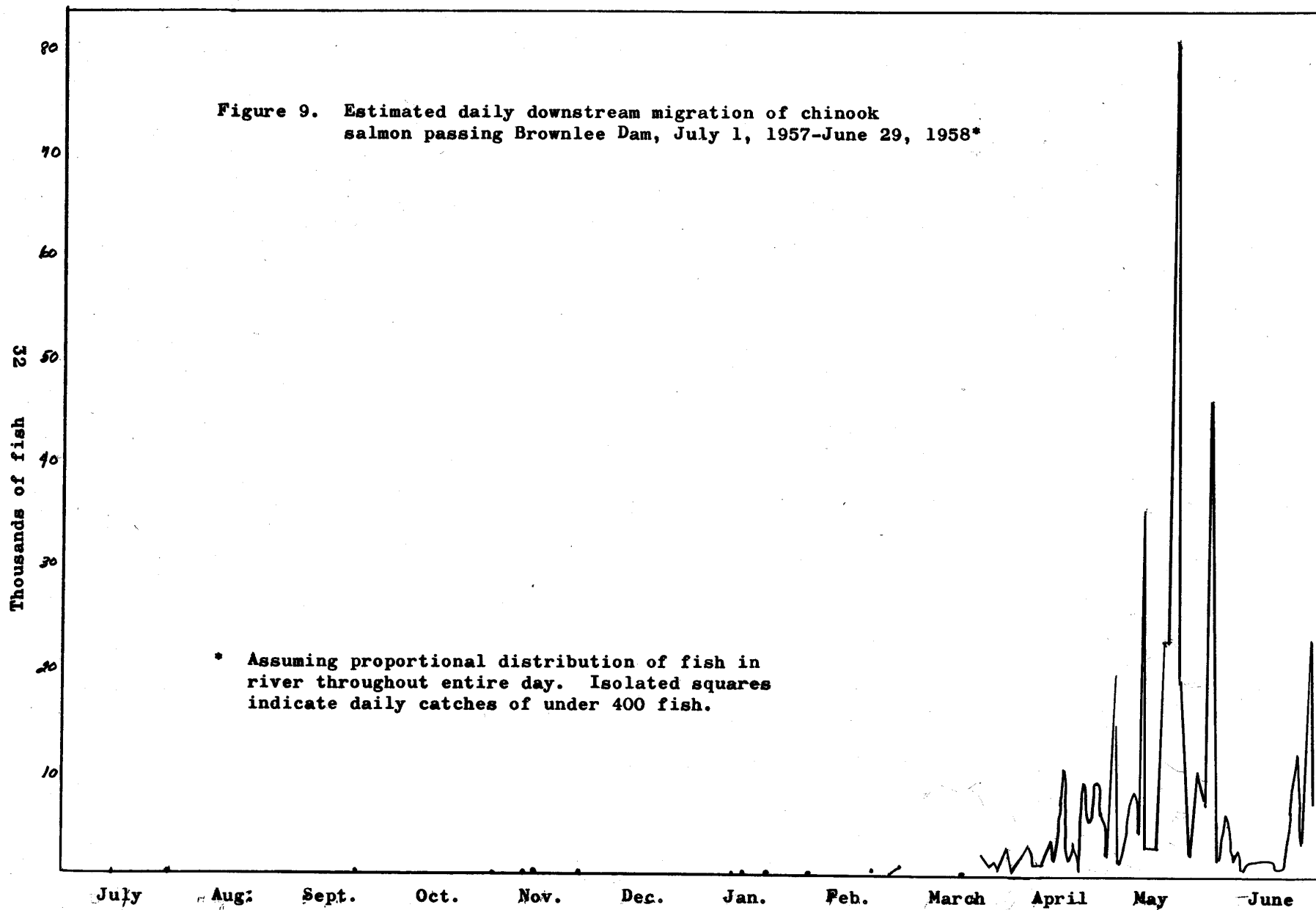
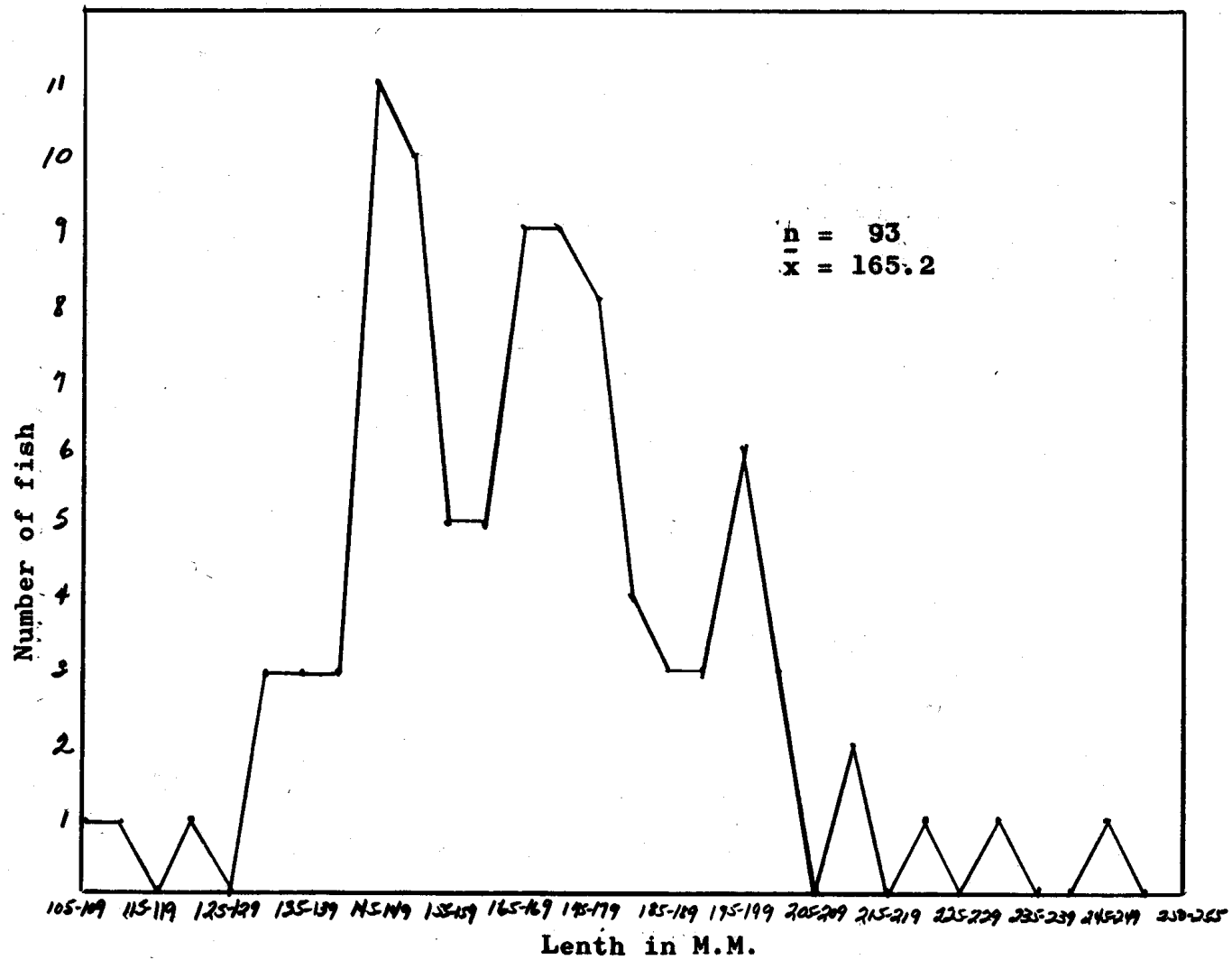


Figure 10. Length frequency distribution of steelhead trout down-Stream migrants caught at Brownlee Dam, April and May, 1958.



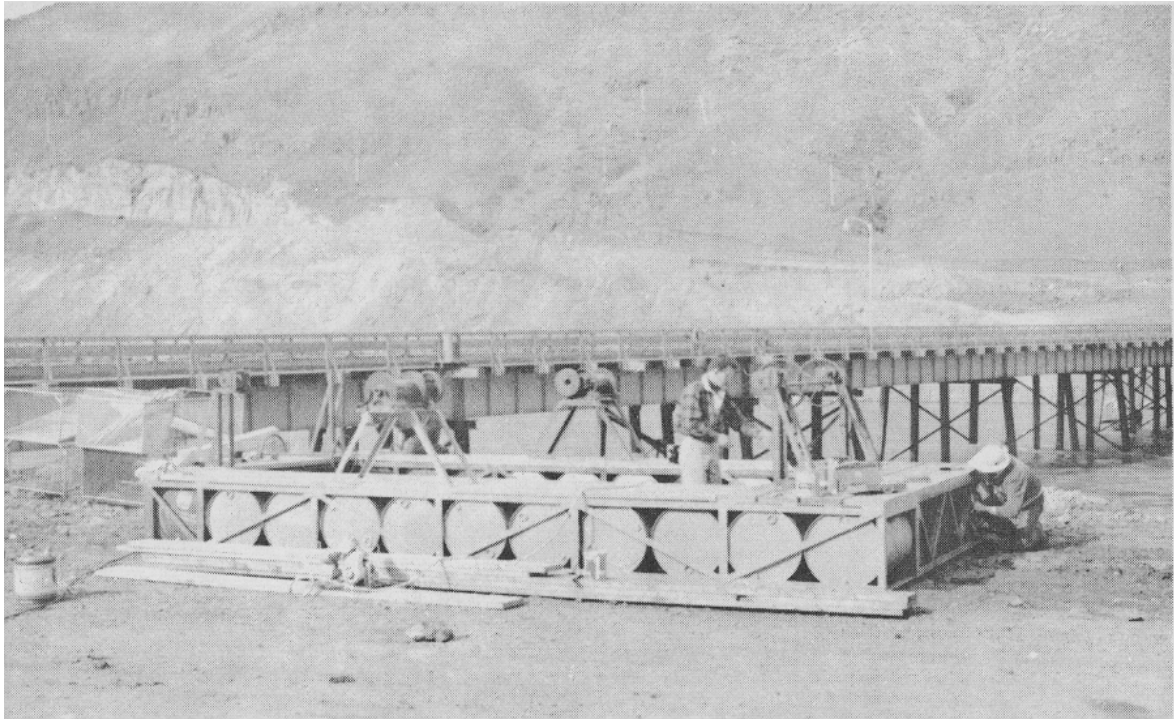


Plate 1. Downstream migrant trapping barge in process of being assembled on Idaho shore at Brownlee Dam. Barge was secured to pilings of bridge shown in background with steel rope.

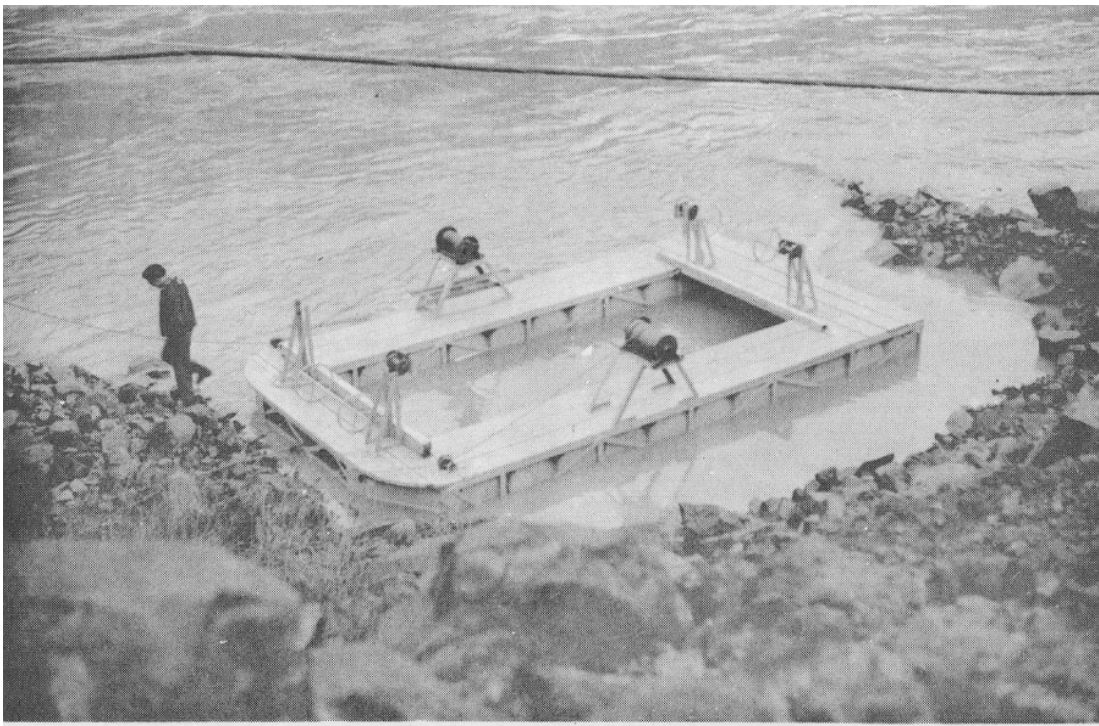


Plate 2. Trapping barge after being lowered into river below bridge with crane. Trap has not been installed on barge.

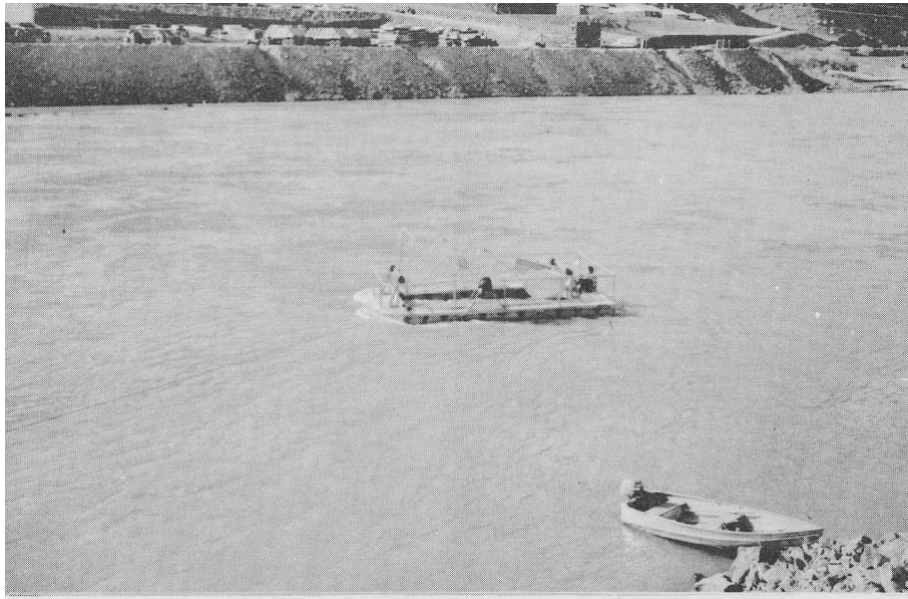


Plate 3. Barge-trap shown with downstream trap out of water.

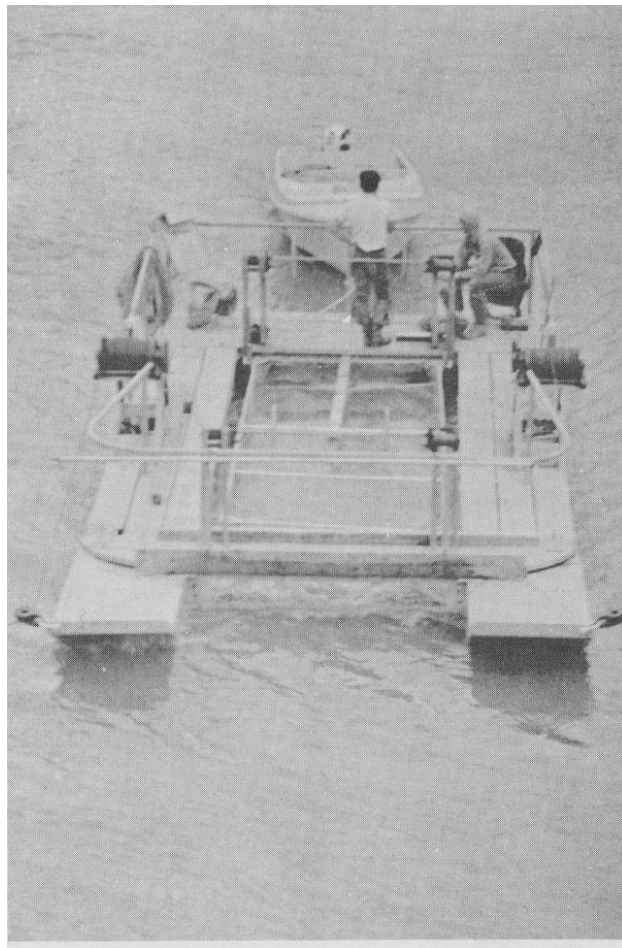


Plate 4. Trapping barge shown with trap in fishing position. Pontoons on front of barge were added to give additional buoyancy and a planning effect for fishing in higher velocities.



Plate 5. Chinook salmon fingerling approximately 70 mm. in length taken in barge-trap. Trough used for measuring downstream migrants is shown in upper right hand corner.

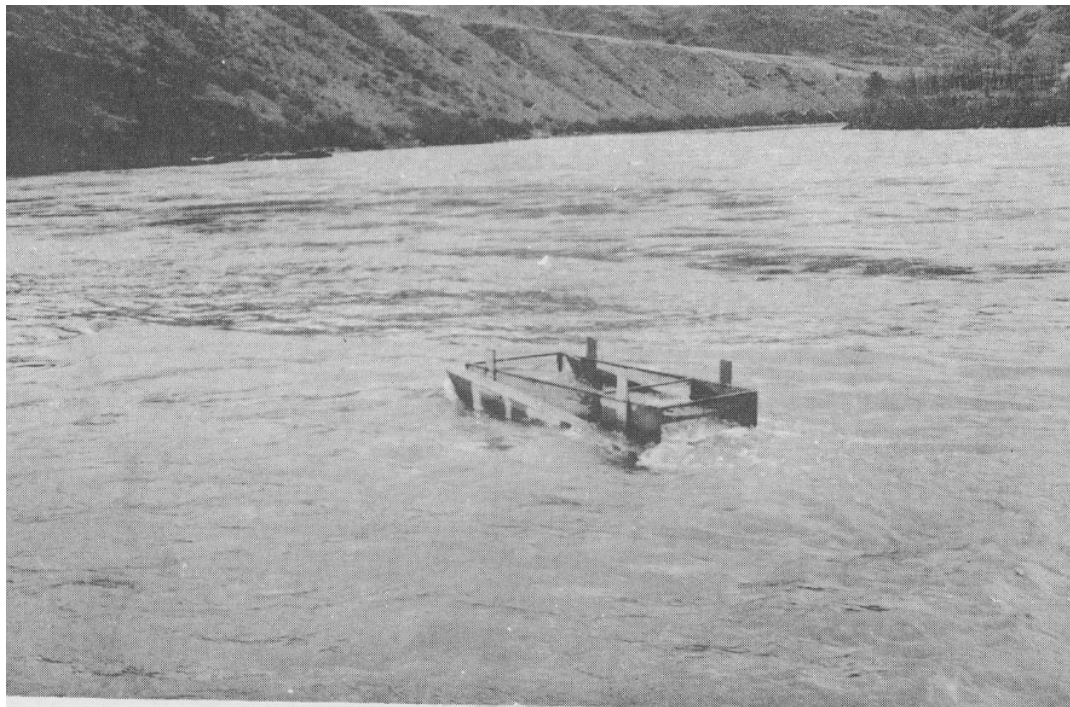


Plate 6. Floating scoop trap of the Kray-MeeKin type shown fishing in Snake River.